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PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improved Method of and Apparatus for Sterilizing Water and other Potable Liquids.

Communication from:—C. F. Burgess Laboratories, Madison, County of Dane, State of Wisconsin, United States of America, a corporation organised under the laws of the State of Wisconsin, United States of America.

I, William John Mellersh-Jackson, of the Firm of Haseltine, Lake & Co., Chartered Patent Agents, 28, Southampton Buildings, London, in the County of Middlesex, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention relates to a process of and apparatus for sterilizing a comparatively small quantity of water by an electrolyzing action to free it from typhoid and other dangerous disease germs and bacteria. The process is available for instant use by travellers, soldiers and others for quickly treating water and other portable liquids, the purity of which is questionable, so that the danger of drinking them is minimized or completely obviated without filtering or boiling the liquid. The invention is also of use to dentists, surgeons, and in sterilizing operations generally.

The method consists in locally electrolyzing in the water to be sterilized a small amount of a suitable electrolyte, which then liberates nascent products capable of diffusing throughout the water and sterilizing it without rendering it salty to taste. Preferably, the electrolyte consists of a solution of a suitable salt, such as sodium chloride, which upon being electrolyzed, produces a hypochlorite that liberates nascent oxygen. The diffusion thereof throughout the water may be facilitated by moving the electrolyzing apparatus around in the water. The process is aided by impregnating a bibulous material which separates the electrodes of an electrolytic cell with the salt to be electrolyzed, and the extent or duration of the electrolyzing action may be governed by the amount of the salt provided.

Suitable apparatus for carrying out the process may be distinctly portable in character, as illustrated by the fact that a complete equipment for sterilizing 8000 litres of water need not weigh more than a few ounces and may conveniently be carried in a coat pocket for repeated use with but slight readjustment. Such apparatus comprises a portable battery of suitable voltage, and an electrolytic

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cell, the electrolyte for the cell being immediately adjacent the electrodes thereof so as to furnish a locally conductive path for the current flowing from the battery when the cell is immersed in the water to be sterilized. Preferably, the electrodes are suitably spaced apart by a bibulous material carrying the salt used in forming the electrolyte, and the electrolytic cell is connected to the battery by a support which carries electrical conductors between the electrodes of the cell and the terminals of the battery. One of the electrodes may be fastened to the support, whereas the other electrode is yieldingly held in cooperation therewith and is removable from the support so as to permit the removal of the bibulous material from between the electrodes.

In the drawings, Figure 1 is an elevation, partly in section, of one embodiment of the invention; Figure 2 is a sectional elevation of the conical electrodes and the bibulous material; Figure 3 is a section elevation of a modified form of apparatus; and Figure 4 is a front elevation of the same.

The dry cells 1 are connected in series to give about four volts, and are in a suitable container 2 having a screw-threaded socket 3 to receive a terminal plug. A spring 4 cooperates with a brass strip 5 soldered to the negative terminal of the battery, while the other terminal of the battery is provided with a spring strip 6 adapted to engage the central terminal of the plug and thereby complete the circuit from the battery when the switch 4, 5 is closed.

Both electrodes of the electrolytic cell may be of platinum, or the anode may be of platinum or of other inert conductive material, and the cathode may be of silver, nickel or nickel-plated iron or brass, or in fact any metal not acted upon by any of the cathodic products of electrolysis.

In Figure 1 and 2, the two electrodes are carried on the end of a rigid support and handle 7, whereby the electrodes may be inserted in the water and moved about therein. The outer part of this handle is a metal tube having one end threaded for engagement with the socket 3, and within the tube is a filler 8 of glass, hard rubber, or the like. The conductor 9 extends from the terminal engaging the strip 6 to the anode 10, which is rigidly attached to the conical enlargement of the filler. The cathode 11 is conical with a slit to make it yielding and may be perforated to permit better diffusion of the products of electrolysis. It is mounted on a nickel supporting bar 12 which carries a spring clip 13[1] movable along the tube 7 in slipping off the cathode to renew the bibulous material, and serving to establish electrical connection therewith.

The term "electrolytic cell" is intended herein to mean two electrodes and an intervening electrolyte. In the use of the apparatus disclosed, means is provided for establishing the electrolyte between the electrodes when current is to be passed between them, but this need not be done until after the electrodes have been introduced into the body of liquid to be sterilized, and can be done conveniently by initially providing between the electrodes a bibulous material such as paper containing a suitable soluble salt so that on introduction of the electrodes into the water to be sterilized, the water penetrates the bibulous material forming a conductive salt solution in the immediate neighbourhood of the electrodes and without imparting to the main body of water a sufficient quantity of salt to render it practically conductive or salty to the taste. The electrolytic cell thus made complete by the addition of the small amount of water necessary to dissolve the salt, is the agency whereby under the action of the current, the sterilizing materials are produced and from which the sterilizing materials may diffuse throughout the entire body of water to be sterilized.

Ordinary drinking water is substantially non-conductive for current of the low potentials here involved, and according to the method herein disclosed, the main body of water to be sterilized remains substantially non-conductive at all times and does not carry current, and participates in the electro-chemical action only to the extent of absorbing from the cell the sterilizing agencies as

they are produced in nascent condition by the passage of current through the cell.

The bibulous element 13 suitably separates the electrodes and serves as a means for introducing between them the requisite salt solution. It also serves as a medium wherein the products of electrolysis may react and recombine to yield as their final product the sterilizing agencies here contemplated, holding the several elements and compounds only to the extent necessary for the production of the desired reactions and then liberating the ultimate products into the surrounding body of water where the sterilizing effect is to be produced.

The bibulous material may be ordinary filter paper, asbestos, cloth, gelatin, or the like, which has been impregnated with an appropriate salt solution, such as sodium chloride solution, and then dried, and may be shaped to the form of a truncated cone to slip over the conical anode 10, or, if desired, may be in the form of a flat, straight strip, which can be wound about the conical anode. Although sodium chloride appears to be the most satisfactory salt for this purpose, because it is so readily obtained, other chlorides such as calcium chloride or potassium chloride could be used, and it is even possible to use the corresponding bromides and iodides. The quantity of salt carried by the bibulous material can be varied through wide limits, and also can be used as a means for automatically regulating the quantity of sterilizing agents liberated in a body of water. By putting a very small quantity of salt in the bibulous material, the electrolyte formed therefrom can be so completely used by thorough electrolytic decomposition and through diffusion into the surrounding water that the resistance to the flow of current between the electrodes will become high and the flow of current will thereby be substantially stopped. In addition to the decomposition of the salt solution, there is of course some diffusion of it outward into the surrounding unsalted body of water, and some of it is mechanically carried away by the hydrogen bubbles which come out vigorously when the cell is in action, and are in a measure relied on to distribute the hypochlorite or other sterilizing agent throughout the body of water. Even though the bibulous material may carry salt far in excess of that necessary for complete sterilization of the body of water, there will not be enough salt present to give to the water as a whole a salty taste.

In Figures 3 and 4, the nickel cathode 14 is carried on the end of a resilient conductor 15 slidingly mounted in a socket 16, which is positioned on the side of the supporting tube 17. The terminal plug 18 is adapted to engage the threaded socket 3 of the battery. Tube 17 is of nickel and has its lower end spread out to a circular form for the reception of a glass plate 19 held in place by cement and bearing on its exposed surface the platinum anode 20, which may be either in the form of a plate cemented in position, or a mere facing of platinum burned or electro-plated on the glass. This anode is connected to a conductor 21, which passes through the tube 17 and is insulated therefrom by cement. The bibulous material 22 is in the form of a round disc, and is yieldingly held between the two electrodes because of the resiliency of wire 15, and can be renewed upon pulling the electrodes apart.

The electrolytic cell is placed in a body of water, say a tumbler full, as shown in Figure 1, or a pail full, and the water soaking into the bibulous material forms the electrolyte from the salt, whereupon the switch 4, 5 is closed to pass current through the electrolyte. If sodium chloride is used, the anode product is chlorine, and the cathode product is sodium, which immediately reacts with the water to form sodium hydrate (NaOH), liberating hydrogen which escapes in the form of bubbles with vigorous agitation of the liquid being sterilized. The chlorine, which is soluble in water and very soluble in alkaline solution, reacts with the sodium hydrate, forming sodium hypochlorite (NaOCl). Sodium hypochlorite is one of the most powerful sterilizing agents known, and even in the proportions of one part to a million parts of drinking

water renders the water substantially sterile. In addition, it is harmless in itself even when present in many times the quantity necessary for complete sterilization, and may be considered beneficial for consumption.

It has been ascertained by bacteriological tests that the sterilizing effect of this method begins immediately, even with typhoid bacteria, and complete sterilization may be effected in a few seconds, though no harm will result from continuing the electrolyzing action for a much longer time. Complete sterilization takes place long before the water acquires an appreciable odour from the hypochlorite, but by continuing the action until the odour is detected the operator may be sure that complete and absolute sterilization has been effected. However, it is not necessary to carry the reaction that far, for the evolution of gas bubbles from the electrodes indicates the activity of the electrolytic process, and with brisk evolution of gas there is nothing to be gained by continuing the action for more than a fraction of a minute.

On the basis of four pounds of sodium hypochlorite to a million gallons of water only .000265 grammes of common salt need be decomposed per litre of water sterilized, and the quantity of current theoretically required to decompose the salt is .45 ampere seconds per litre of water, or assuming a current efficiency of 33%, is 1.35 ampere seconds per litre. A small size or vest pocket battery will furnish sufficient energy to sterilize over 1,000 litres, and the larger size of pocket batteries commonly used for flash lights give enough current to sterilize about 8,000 litres.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A process of sterilizing water and other potable liquids, which consists in introducing into the liquid an electrolytic cell or cells, forming a local electrolyte between or adjacent the electrodes of said cell or cells and subsequently passing an electric current between the electrodes so that the nascent products of the resulting electrolyzing action can diffuse in the surrounding liquid to sterilize the said liquid.

2. A process in accordance with the preceding first claiming clause, characterised in that the extent or duration of the electrolyzing action is governed by the quantity of material introduced into the liquid to form the local electrolyte.

3. Apparatus for the purpose of the preceding claiming clause, the said apparatus comprising an electrolytic cell provided with electrodes capable of being electrically connected to a portable electric battery or other source of electric current, the said electrodes being accompanied by such material as will form an electrolyte on immersion of the electrodes in the liquid to be treated.

4. In apparatus in accordance with Claim 3, the use of a bibulous material which suitably spaces apart the electrodes of the cell and carries a salt from which the electrolyte is formed.

5. Apparatus in accordance with Claims 3 or 4, characterised by the fact that the electrolytic cell is secured to the battery by a support which carries electrical conductors between the electrodes of the cell and the terminals of the battery.

6. Apparatus in accordance with Claim 5, characterised by the fact that the support rigidly holds one of the electrodes whereas the other electrode is yieldingly held in co-operation therewith.

7. Apparatus as in Claims 5 or 6, characterised by the fact that one of the electrodes is detachably secured to the support and is removable therefrom so that the bibulous material may be removed.

8. The process of and apparatus for sterilizing water and other potable

liquids substantially, as hereinbefore described and illustrated in the accompanying drawing.

Dated this 4th day of May, 1916.

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Fig. 1.

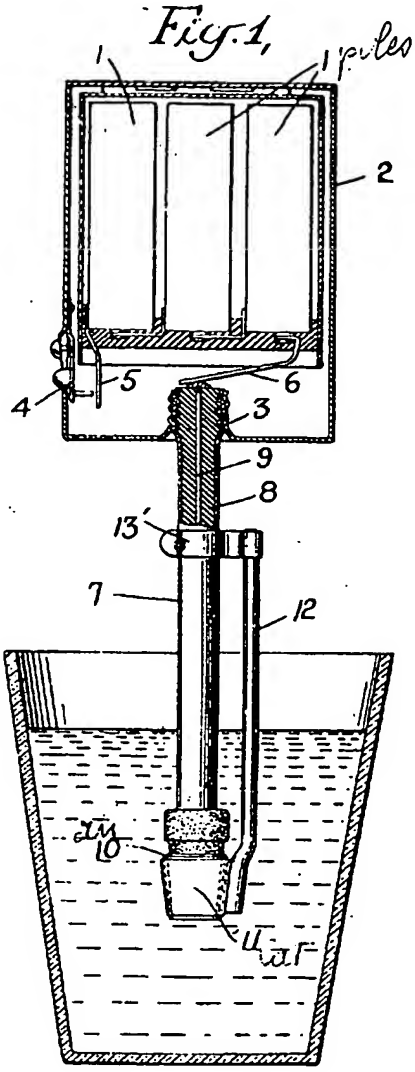


Fig. 2.

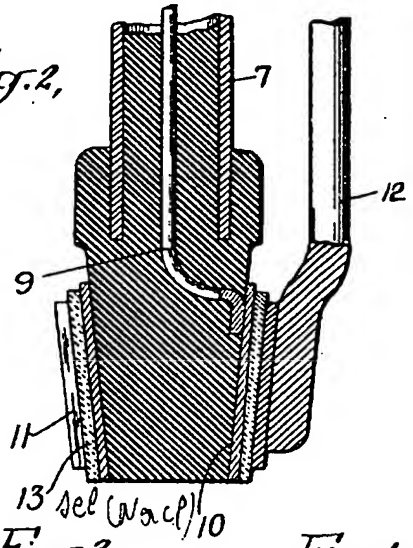


Fig. 3.

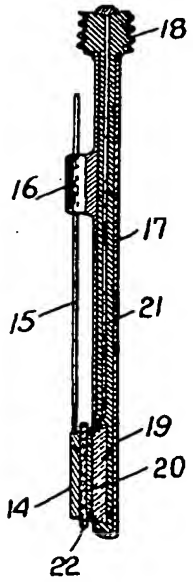
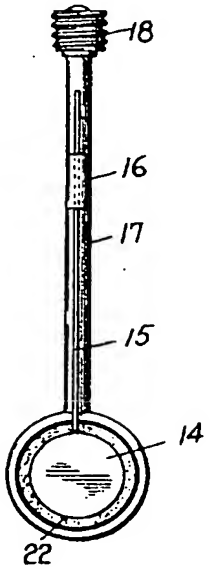


Fig. 4.



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